

A new species of *Coleophora* (Lepidoptera: Coleophoridae: Coleophorinae) from the Galápagos Islands, Ecuador

JEAN-FRANÇOIS LANDRY

Agriculture and Agri-Food Canada, Neatby Building, 960 Carling Avenue, Ottawa, Ontario K1A 0C6, Canada. Email: landryjf@agr.gc.ca

Abstract

Coleophora darwini **sp. nov.**, is described from the Galápagos Islands. This is the first record of the family Coleophoridae for the Galápagos. Adults were reared from larvae found mining leaves of *Amaranthus andersonii* Howell (Amaranthaceae) on Pinzón Island. Adults of the species also were collected at light on the islands of Española and Pinta. *Coleophora darwini* is similar to *C. intexta* Meyrick, 1917 from Peru. Adults, and male and female genitalia of both species, as well as the larval case of *C. darwini*, are illustrated and morphological characters distinguishing the two species are presented. A lectotype is formally designated for *C. intexta*.

Key words: *Coleophora*, Coleophoridae, Galápagos, *Amaranthus*

Introduction

Coleophora is one of the largest genera of Lepidoptera with 1326 described species and numerous undescribed ones worldwide (Baldizzone *et al.* 2006). The larvae of most species of *Coleophora* are leaf miners or seed miners in various primarily dicotyledonous plants. Most species occur in the Northern Hemisphere. In contrast, only 11 species have been reported from the Neotropical Region (Pastrana 1963; Frías *et al.* 1996; Wolf 1999). Although numerous undescribed species from the Northern Hemisphere reside in collections, the number of undescribed species from the Neotropical Region appears to be very small (J.-F. Landry, unpublished data) and probably reflects a much lower diversity in that part of the world. The material forming the basis of this study was collected by Bernard Landry, who has conducted extensive surveys of Lepidoptera in the Galápagos Islands, documented the first records of several families of microlepidoptera, and described many new endemic species from these islands (Heppner & Landry 1994a; Heppner & Landry 1994b; Landry & Landry 1998; Landry & Neunzig 1998; Landry 2001a; Landry 2001b;

Landry 2002; Landry & Roque-Albelo 2004). The present paper is the first report of the presence of *Coleophora* and of the family Coleophoridae for the archipelago.

Materials and methods

Specimens from 1992 were collected at mercury-vapour light. Specimens from 2002 were collected on the host plant either as adults or as mature cases from which emerged most of the specimens. Syntypes of *Coleophora intexta* Meyrick were borrowed from the Natural History Museum (London), dissected, and examined for comparison. During my ongoing investigation of the *Coleophora* of the New World I examined photographs and drawings of the genitalia of a male and a female syntype of *intexta*. From these the close similarity to the species present in the Galápagos was established, which prompted me to examine additional specimens.

When citing label data, text from different label lines is separated by slashes, and abbreviated words are spelled out between square brackets.

Genitalia dissections were prepared following the technique in Landry and Wagner (1995). Terms for genital parts follow Landry and Wright (1993). Specimens were photographed with a Nikon DMX 1200F digital camera mounted on a Nikon SMZ 1500 stereoscope with a 0.5x objective. Automontage[®] software was used to assemble multiple images in successive planes of focus into single deep-focus images. Specimens were illuminated with a fiber-optic ring light which was diffused with a white styrofoam cup placed around the specimen. Slide-mounted genitalia were photographed with the same camera as the pinned specimens but mounted on a Nikon Eclipse 800 microscope at magnifications of 100x or 200x. To illustrate the dorsal aspect of the juxta rods, the aedeagus-juxta complex of the male was separated from the genitalia before dehydration and embedding in Euparal, structures were immobilized between small pieces of glass immersed in lactic acid on a ringed slide, and drawn with a camera lucida as viewed through a Nikon Optiphot compound microscope at a magnification of 200x.

The following institutional acronyms are used:

BMNH	The Natural History Museum, London, U.K.
CNC	Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada
ECCD	Estacion Cientifica Charles Darwin, Santa Cruz Island, Galápagos, Ecuador.
MHNG	Muséum d'histoire naturelle de Genève, Geneva, Switzerland.

***Coleophora darwini* J.-F. Landry, sp. nov.**

(Figs. 1, 2, 5–7, 10, 12, 14, 16–20, 24)

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Diagnosis and similar species. *Coleophora darwini* is a small species with a dark, grey-brown upper surface and forewing veins overlined with white (Figs. 1–2). It is very similar to *C. intexta* Meyrick, 1917, which was described from specimens collected in Lima, Peru. I examined syntypes of *C. intexta* from the BMNH (Figs. 3–4). Both species are similar in colouration of the wings, although the colouration of *C. intexta* syntypes is somewhat faded due to age (they were collected in 1914). There are several consistent differences in the genitalia of both sexes as well as one difference on the abdomen and these characters provide the best means of separating the two species. Of course, geographically the two species are widely vicariant. The geographic range of *C. intexta* is unknown because the species is known only from the type locality.

In both sexes of *C. darwini*, abdominal tergum 1 lacks the paired patches of spinules present on T2–T7 (Figs. 6–7). In both sexes of *C. intexta*, the paired patches of spinules are present on T1 as well as T2–T7 (Figs. 8–9).

The male genitalia of *C. darwini* (Figs. 10, 12, 14) have the base of the vinculum rounded, U-shaped; the sacculus apical emargination is shallow and irregularly dentate or crenulate; the valvula has an irregularly sinuate outer margin and bears setae that are more or less evenly spaced (Fig. 10); the ventrobasal process of the juxta is smoothly rounded and asymmetrically sinuate with the deep end of the sinuation located at the posterior end of the process, and the ventral projection is small relative to the mid-section of the process; the dorso-subapical tooth of the right rod of the juxta is slender (Figs. 12, 14); the cornuti are small, indistinct, 2–5 in number (Figs. 16–20); the vesica has its widest part about its middle and a very indistinct ventral lamina (Figs. 12).

The male genitalia of *C. intexta* (Figs. 11, 13, 15) have the base of the vinculum angular, V-shaped; the sacculus distal processes have a more pronounced forked appearance, the apical emargination is more or less evenly rounded, more excavated than in *C. darwini*; the valvula has the outer edge regularly sinuate and bears setae that are distinctly thickened and clumped (Fig. 11); the ventrobasal process of the juxta is markedly angulate and more or less symmetrically emarginate, and the ventral projection is proportionally larger relative to the mid-section of the process; the dorso-subapical tooth of the right rod is thicker with a sharper apex (Figs. 13, 15); the cornuti are much larger than those of *C. darwini*, well sclerotized, grouped in a tight bundle, 5–10 in number (Figs. 21–23); the vesica has its widest part in its anteriormost section and a distinct, albeit lightly sclerotized, ventral lamina (Fig. 13).

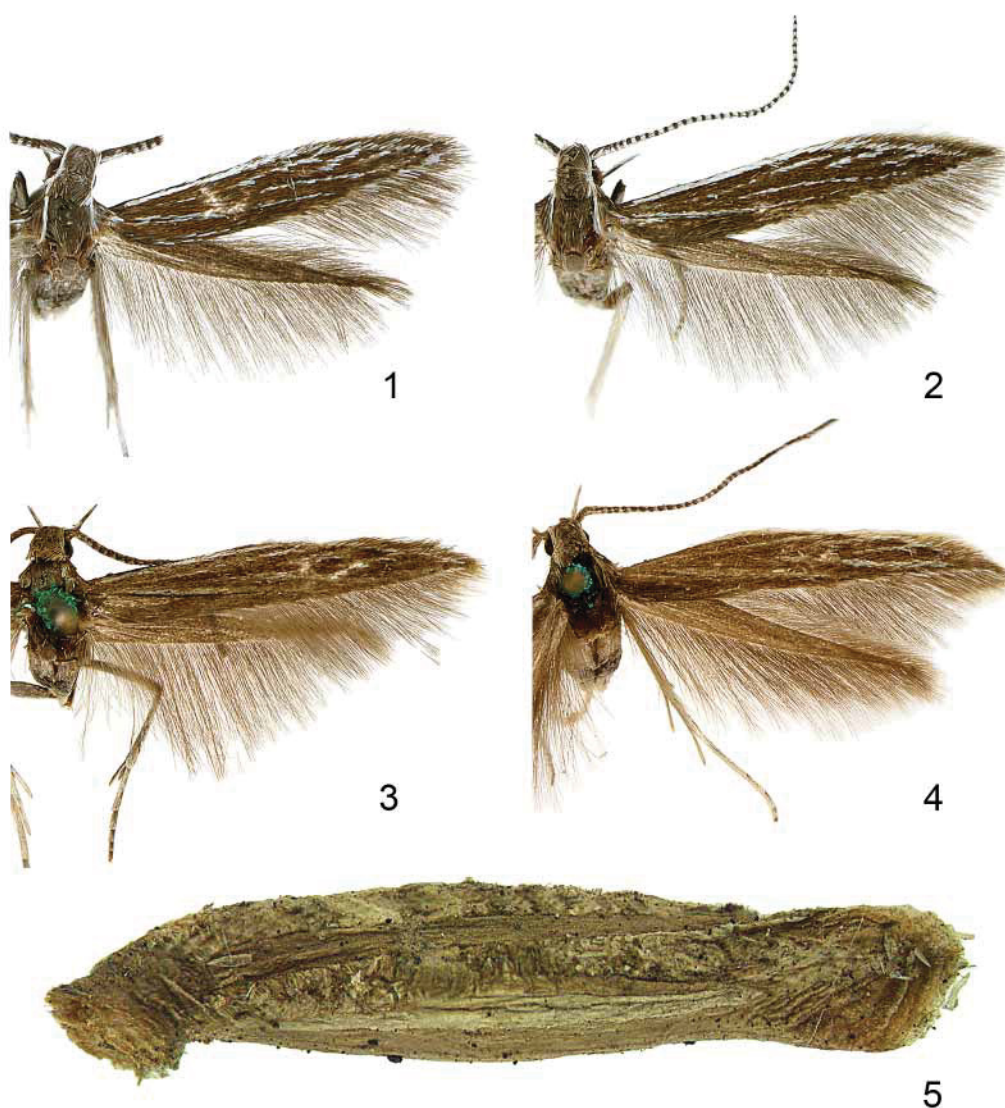
The female genitalia of *C. darwini* (fig. 24) have the lateral portion of the sterigma as long as wide; the colliculum proportionally narrow, about 2x as long as wide and parallel-sided; the ostium bursae is narrower in relation to the width of S8; the section of ductus bursae between the colliculum and the ductus seminalis is equal in length to the colliculum; the corpus bursae is subspherical.

The female genitalia of *C. intexta* (fig. 25) have the lateral portion of the sterigma 1.5x longer than wide; the colliculum proportionally broader (width about 0.75x length) and anteriorly widened; the ostium bursae wider in relation to the width of S8; the section of ductus bursae between the colliculum and the ductus seminalis is 2x the length of the colliculum; and the corpus bursae is more slender, ovoid.

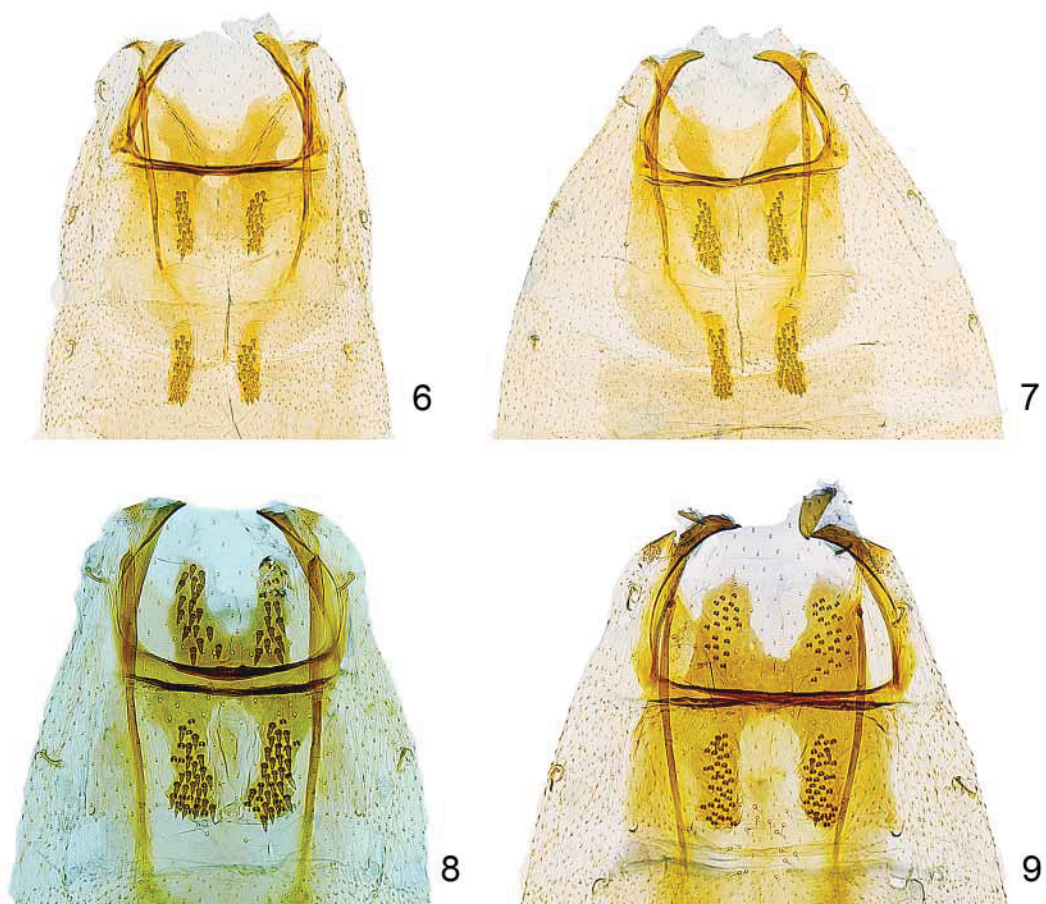
Description. Head and thorax (Figs. 1–2). Wingspan, males 7.8–9.4 mm (mean = 8.6 mm, 12 specimens), females 8.4–10.6 mm (mean = 9.3 mm, 17 specimens). Head brownish grey except margin above eye (outer edge of frontoclypeus and postgena) white. Labial palpus white with longitudinal band of brownish grey on both outer and inner side of second and third article. Haustellum basal scales white with brownish-grey band medially in basalmost section. Antenna with scape brownish grey; flagellum annulated with alternating white and brownish grey, articles thicker in basal section, gradually thinner towards apex. Dorsum of thorax and tegulae brownish grey like head; inner margin of tegula lined with white continuing from white line behind eye, and with anterior scale tuft (the one extended below the wing costa) white. Underside of thorax white. Legs white with longitudinal brownish-grey stripe on outer side, dark stripe wider on tarsi giving near annulate appearance. Forewing upper surface (Figs. 1–2) predominantly brown, costa and termen lined with white, extreme edge of costa in basal half brown, apical third of costa lined with dark grey beyond white line, main veins overlaid with white lines, cilia brownish grey. Hindwing upper surface uniformly brownish grey, cilia the likewise coloured. Underside of forewings brownish grey with dirty white suffusion in distal third.

Abdomen. Upper side of abdomen grey, ventral side dirty white, terminal segment with distinct yellow tinge in female. Terga 2–7 with paired patches of 20–25 small spines each, fewer on T7; T1 with roughly V-shaped melanized zone in posterior half and without spines (Figs. 6–7).

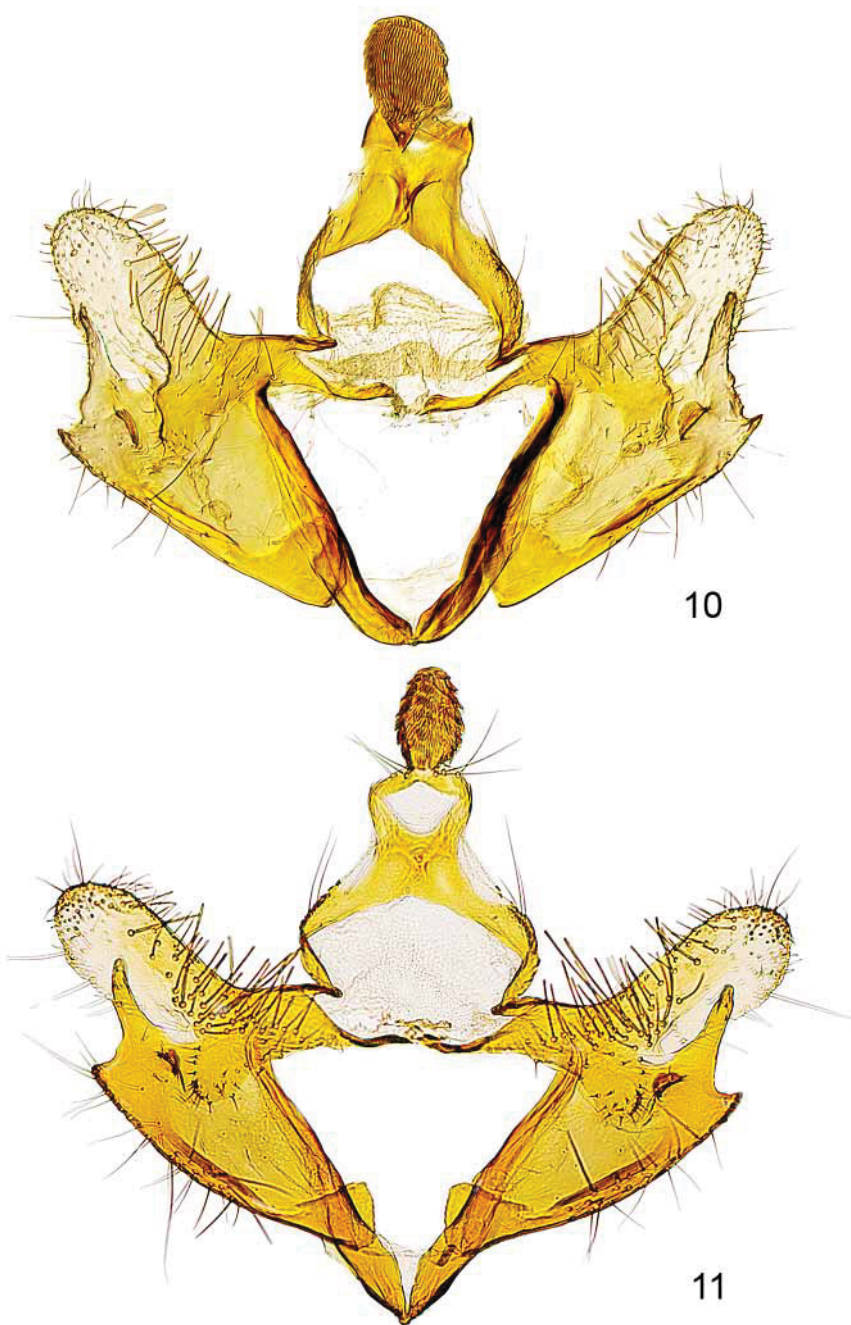
Male genitalia (7 preparations examined) (Fig. 10). Peduncular arms about equal in length to medial portion of tegumen. Spinose knob of gnathos suborbicular with 8–9 rows of spines. Vinculum base V-shaped, rounded. Valvula indistinctly delineated, outer margin irregular, setae slightly thicker than elsewhere on valva and more or less evenly spaced. Apical portion of sacculus with both dorsal and ventral process, apical emargination shallow and irregularly jagged, dorsal process elongate and extended dorsally, ventral process small, sharp, and protruding apically; a rounded tooth situated between saccular processes and slightly offset from margin; ventral margin of sacculus medially with ridge-like thickening. Cucullus broadly rounded, extended a little beyond apex of sacculus. Ventral process of juxta (Fig. 12) smoothly sinuate, deep end of sinuation situated posteriorly, ventral projection small relative to mid-section. Juxta rods (Fig. 14) asymmetrical, right rod shorter than left one, nearly straight, distal portion slightly dilated (dorsal view) with single preapical upcurved tooth; left rod slightly incurved, distally tapered. Aedeagus (Fig. 12) membranous and dilated, situated anterad of juxta, annulus distinctly sclerotized, cornuti 2–5, very small and in tight bundle, indistinct in some specimens; vesica longer than aedeagus proper, widest point near middle, lacking distinct lamina and coiled appendix.



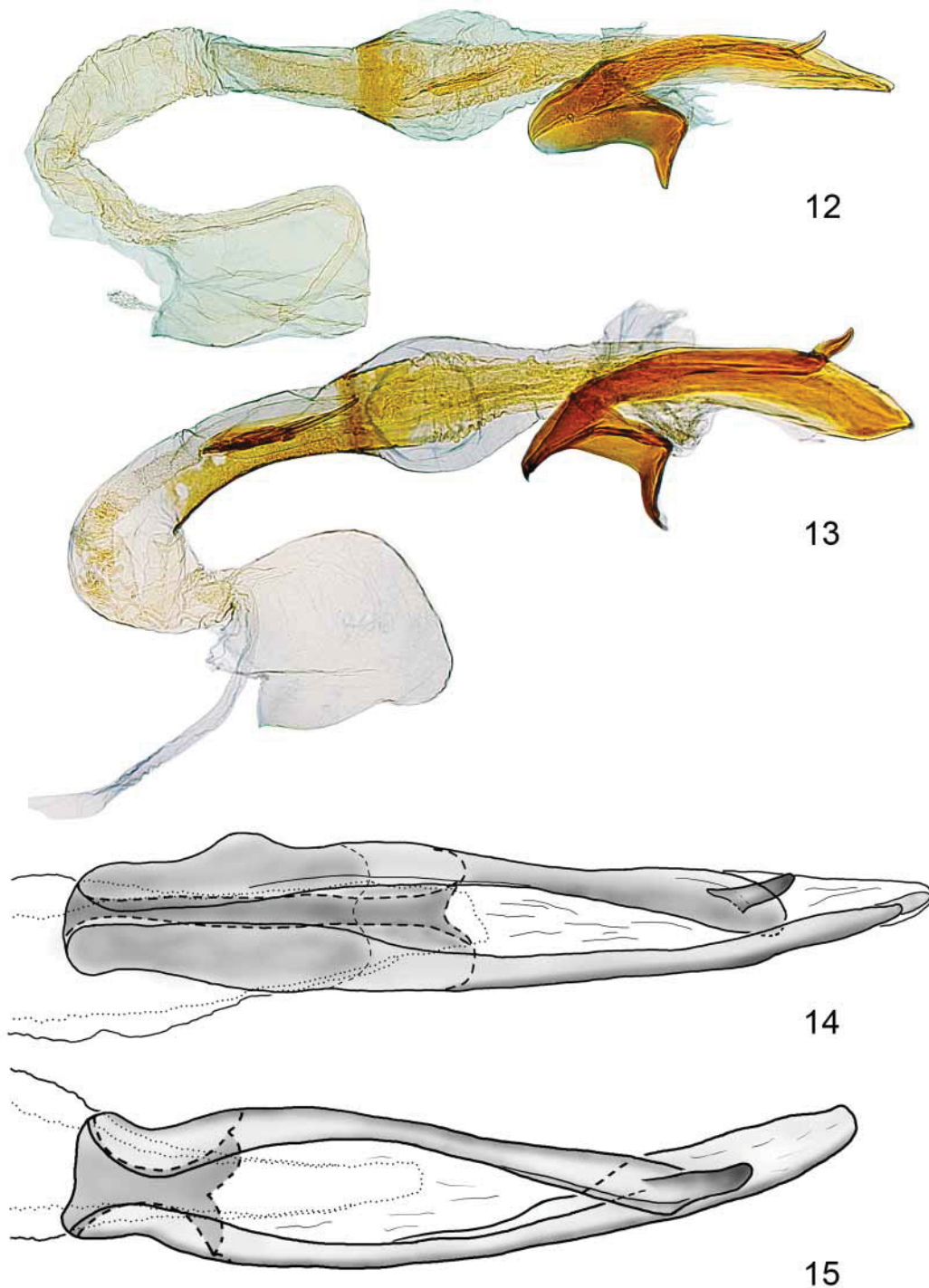
FIGURES 1–5. *Coleophora* spp., adults. 1, *C. darwini* ♂, holotype, Ecuador, Galápagos, Pinzón, ex *Amaranthus anderssonii*, specimen CNCLEP00001264 (MHNG), reversed left side shown ; 2, *C. darwini* ♀, paratype, Ecuador, Galápagos, Pinzón, ex *Amaranthus anderssonii*, specimen CNCLEP00001275 (CNC). 3, *C. intexta* ♂, lectotype, Peru, Lima (BMNH); 4, *C. intexta* ♀, paralectotype, Peru, Lima (BMNH). 5. *C. darwini*, mature larval case, Ecuador, Galápagos, Pinzón, on *Amaranthus anderssonii*, specimen CNCLEP00001278 (CNC).



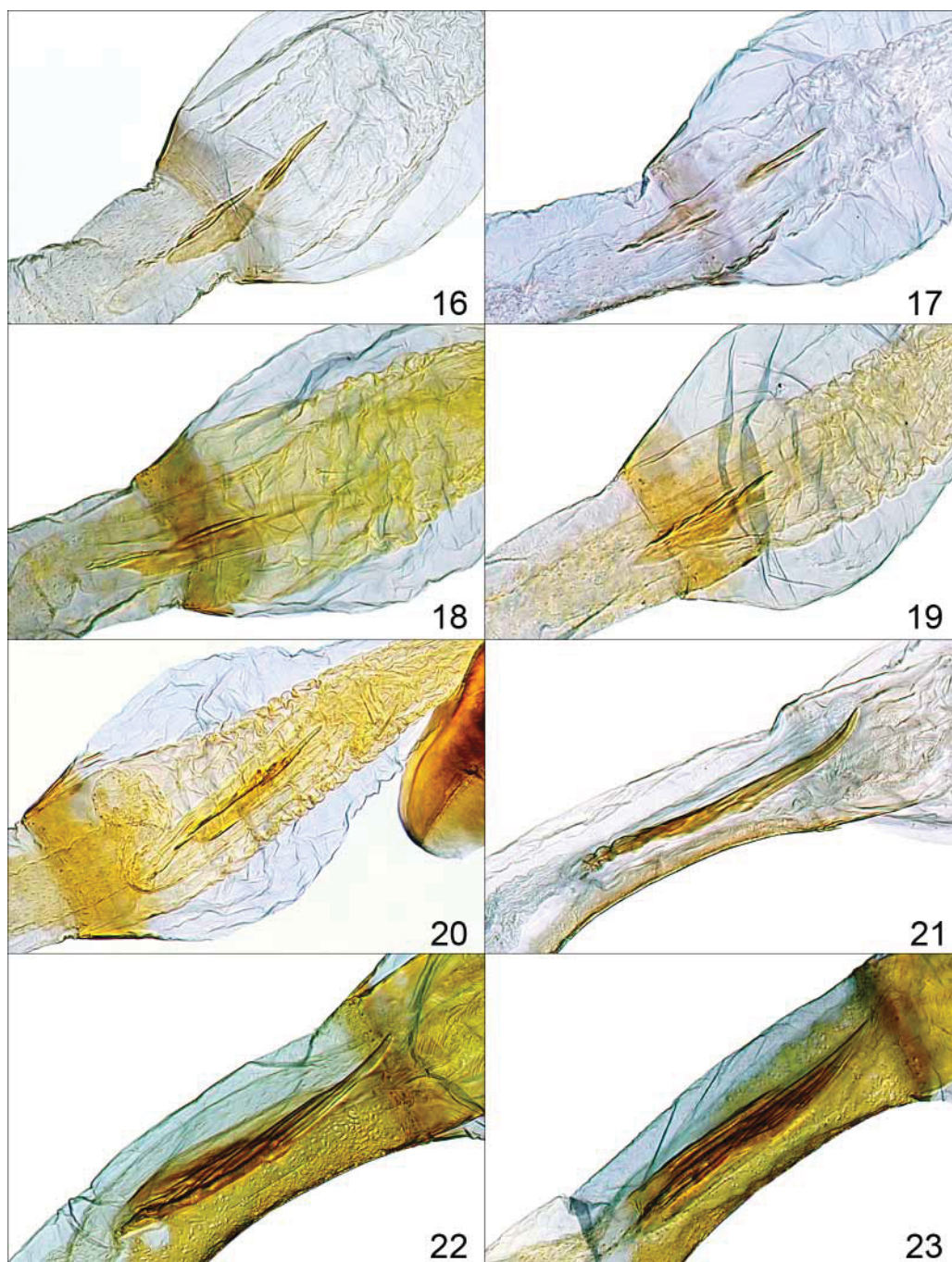
FIGURES 6–9. *Coleophora* spp., base of abdominal terga (scales removed) showing paired spined patches. 6, *C. darwini* ♂, slide MIC4882, specimen CNCLEP00001265 (CNC); 7, *C. darwini* ♀, slide MIC 4883, specimen CNCLEP00001275 (CNC); 8, *C. intexta* ♂, slide BM 30727 (BMNH); 9, *C. intexta* ♀, slide BM30730 (NMNH).



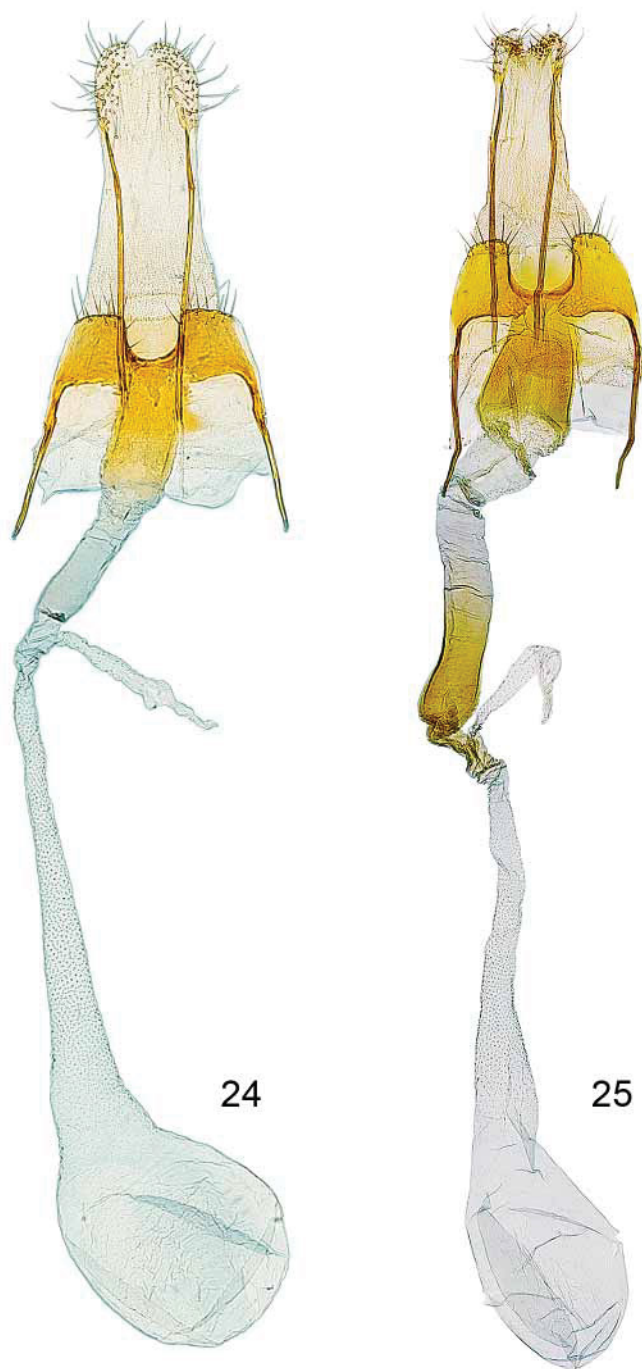
FIGURES 10–11. *Coleophora* spp., male genitalia spread in posteroventral aspect. 10, *C. darwini*, slide JFL 1583, specimen CNCLEP00001280 (MHNG); 11, *C. intexta*, slide BM 30727 (BMNH).



FIGURES 12–15. *Coleophora* spp. 12–13, aedeagus–juxta complex in left lateral aspect; 14–15, juxta rods in dorsal aspect. 12, *C. darwini*, slide MIC4882, specimen CNCLEP00001265 (CNC); 13, *C. intexta*, slide BM 30727 (BMNH); 14, *C. darwini*, slide JFL 1583, specimen CNCLEP00001280 (MHNG); 15, *C. intexta*, slide BM 30728 (BMNH).



FIGURES 16–23. *Coleophora* spp., closeup of cornuti of male aedeagus. 16, *C. darwini*, slide JFL 1583, specimen CNCLEP00001280 (MHNG); 17, *C. darwini*, slide JFL 1581, specimen CNCLEP00001271 (MHNG); 18, *C. darwini*, slide JFL 1617, specimen CNCLEP00001281 (MHNG); 19, *C. darwini*, slide MIC 4778, specimen CNCLEP00001283 (CNC); 20, *C. darwini*, slide MIC 4882, specimen CNCLEP00001265 (CNC); 21, *C. intexta* lectotype, slide BM 12224 (BMNH); 22, *C. intexta*, slide BM 30727 (BMNH); 23, *C. intexta*, slide BM 30728 (BMNH).



FIGURES 24–25. *Coleophora* spp., female genitalia, ventral aspect. 24, *C. darwini*, slide JFL 1580, specimen CNCLEP00001267 (MHNG); 25, *C. intexta*, slide BM 30729 (BMNH).

Female genitalia (8 preparations examined) (Fig. 24). Tergum 8 membranous. S8 (sterigma) short, transverse, each lateral portion as wide as long and with posterior margin lined with fine setae; medial invagination of ostium bursae nearly as deep as length of sterigma. Colliculum as wide as ostium, parallel-sided, twice as long as wide. Ductus bursae membranous, without spinules and lamina, more or less straight; section between colliculum and ductus seminalis about equal in length to colliculum and lightly sclerotized. Corpus bursae subspherical, without signum. Anterior apophyses 2.5–3x length of S8. Ovipositor 5x length of S8; papillae anales membranous, elongate.

Larval case (Fig. 5). Of the tubular silk case type, trivalved, valvae flared, anterior end constricted before mouth, mouth at 30° angle. Light brown in colouration, with distinct longitudinal stripes of various shades of beige or brown demarcating silk additions from progressive stages of girth enlargement. Length of mature case 5.5–6.9 mm (mean = 5.9 mm, 13 specimens measured).

Type material. Holotype ♂: [label 1] “ECU, Galápagos, Pinzón / circa 25m elev., day / 20.iv.2002 / leg. B. Landry”; [label 2] “case on *Amaranthus / anderssonii* / em.: 23.iv.2002”; [label 3, green] “genitalia slide ♂ / JFL 1579”; [label 4] “Database # / CNC LEP / 00001264”; [label 5, orange] “HOLOTYPE ♂ / Coleophora / darwini / J.-F. Landry” (MHNG).

Paratypes 11 ♂, 18 ♀, including 7 male and 7 female genitalia preparations.

6 ♂, 11 ♀: ECUADOR, Galápagos, Pinzón, 0.6200°N, 90.6417°W, circa 25 m elev., leg. B. Landry, ex case on *Amaranthus anderssonii*, emergence dates various: ♂ em. 21 April 2002, CNCLEP00001260 (MHNG); ♂ em. 22 April 2002, CNCLEP00001262, genitalia slide MIC 4777 (CNC); ♂ em. 24 April 2002, CNCLEP00001265, genitalia slide MIC 4882 (CNC); ♂ em. 24 April 2002, CNCLEP00001266, (ECCD); ♂ em. 26 April 2002, CNCLEP00001271, genitalia slide JFL 1581 (MHNG); ♂ em. 29 April 2002, CNCLEP00001276, (MHNG); ♀ em. 21 April 2002, CNCLEP00001261, (MHNG); ♀ em. 22 April 2002, CNCLEP00001263, (BMNH); ♀ em. 24 April 2002, CNCLEP00001267, genitalia slide JFL 1580 (MHNG); ♀ em. 24 April 2002, CNCLEP00001268, (ECCD); ♀ em. 24 April 2002, CNCLEP00001269, (ECCD); ♀ em. 25 April 2002, CNCLEP00001270, (MHNG); ♀ em. 26 April 2002, CNCLEP00001272, (MHNG); ♀ em. 26 April 2002, CNCLEP00001273, (MHNG); ♀ em. 26 April 2002, CNCLEP00001274, (MHNG); ♀ em. 26 April 2002, CNCLEP00001275, genitalia slide MIC 4883 (CNC); ♀ em. 29 April 2002, CNCLEP00001277, genitalia slide JFL 1582 (MHNG).

5 ♂, 3 ♀: same locality data as holotype and above paratypes, adults collected 20 April 2002 by day on *Amaranthus anderssonii* plants where cases also occurred: ♂ CNCLEP00001280, genitalia slide JFL 1583 (MHNG); ♂ CNCLEP00001281, genitalia slide JFL 1617, (MHNG); ♂ CNCLEP00001282, (MHNG); ♂ CNCLEP00001283, genitalia slide MIC 4778, (CNC); ♂ CNCLEP00001284, (BMNH); ♀ CNCLEP00001285, genitalia slide JFL 1584, (MHNG); ♀ CNCLEP00001286, (ECCD); ♀ CNCLEP00001287, (MHNG).

3 ♀: ECUADOR, Galápagos, Española, Punta Suarez, 2 May 1992, at mercury-vapour light, leg. B. Landry; CNCLEP00001288, genitalia slide JFL 1188 (MHNG); CNCLEP00019301, genitalia slide Bldz 13236 (CNC); CNCLEP00002753, genitalia slide JFL 1615 (MHNG).

1 ♀: ECUADOR, Galápagos, Pinta, 15 March 1992, arid zone, at mercury-vapour light, leg. B. Landry, CNCLEP00001289, genitalia slide JFL 1189 (MHNG).

14 larval cases separately pinned and labelled in two sets are associated with the type series and comprise the cases from which adult paratypes emerged: ECUADOR, Galápagos, Pinzón, 0.6200°N, 90.6417°W, 25 m, leg. B. Landry, 20 April 2002, cases on *Amaranthus anderssonii*, CNCLEP00001278 (CNC), CNCLEP00001279 (MHNG).

Host plant. Larvae were found mining the leaves of *Amaranthus anderssonii* Howell (Amaranthaceae) on Pinzón Island. The plants were growing along a trail in the arid zone characterized by microphyllous xerophytic vegetation dominated by cacti and seasonally deciduous trees (Peck 2001). Cases were collected on 20 April 2002 and adults emerged between 22–29 April 2002. Some adults also were collected on the same plants on 20 April at the same time that cases were found. This plant species is endemic to the Galápagos Islands. Little else is known about the life history of this *Coleophora* species. Other native *Amaranthus* species also must be used as host plants because *A. anderssonii* is not present on all islands where *C. darwini* has been recorded. For example, on Pinta, the only species of *Amaranthus* is *A. sclerantoides* Andersson (Lawesson *et al.* 1987). The latter also occurs on Pinzón.

Geographical distribution. Known only from the Galápagos archipelago where it has been collected on Pinzón, Española, and Pinta islands. Adults from the latter two islands were collected at mercury-vapour lights.

Relationships. It is not possible at present to establish which species or species group *C. darwini* may be most closely related to, given the very incomplete knowledge of New World *Coleophora* and the lack of a sound phylogenetic framework for the genus as a whole. In the New World only *C. lineapulvella* Chambers is currently known to use *Amaranthus* species as larval host plants (J.-F. Landry unpublished data). However, this North American species does not appear to be closely related to the *darwini/intexta* species pair because it has very different male and female genitalia, and its larvae are seed-miners rather than leaf-miners.

The absence of paired spined patches on T1 is an uncommon feature in *Coleophora* but this character state (i.e., absence of patches) occurs multiple times in various, seemingly unrelated species of Old World *Coleophora*, as can be ascertained by perusing the illustrations of large faunal works such as Toll (1962) on the Palearctic *Coleophora*, or Baldizzone (1994) on the *Coleophora* of the Irano-Anatolian region. Even though Căpușe (1971) described in great detail the variation across various morphological characters in *Coleophora*, he gave only a very brief statement about the spines of abdominal terga without detailing interspecific variation.

Etymology. Named after Charles Darwin, father of evolution and *naturaliste extraordinaire*, whose visit to the Galápagos Islands fostered his ideas on natural selection.

***Coleophora intexta* Meyrick, 1917: 72**

(Figs. 3–4, 8–9, 11, 13, 15, 21–23, 25)

Meyrick described this species based on 31 specimens collected by Parish in Lima, Peru in August 1914. Presently, there are 14 syntypes in the BMNH, the location of the remainder of Meyrick's original series is unknown. Meyrick ended his description by stating that this was "a variable species" without being more explicit. Six syntypes (3 ♂ and 3 ♀) were examined and their genitalia dissected. I observed little variation in the syntypes that I examined. Considering Meyrick's unconfirmed statement about intraspecific variability, the unknown location of half of the syntypes, and the close similarity between *C. intexta* and *C. darwini*, it is advisable to fix Meyrick's concept of *C. intexta* by designating a lectotype.

Lectotype ♂ hereby designated, labelled as follows: [label 1, round circled with purple] "LECTO- / TYPE"; [label 2] "Lima, 500 ft., / Peru / Parish 8-14"; [label 3] "Coleophora / intexta / 1/14 Meyr. / E. Meyrick det. / in Meyrick Coll."; [label 4, upside down] "Meyrick Coll. / B.M. 1938-290"; [label 5] "B.M. ♂/ Genitalia Slide / No. 12224"; [label 6, orange] "LECTOTYPE ♂ / Coleophora / intexta / Meyrick, 1917 / by J.-F. Landry 2005" (BMNH).

Pastrana's (1963) treatment of this species in his review of the Argentinian *Coleophora* is essentially a Spanish translation of Meyrick's description and is not accompanied by illustrations, suggesting that he did not examine specimens. I have not seen further specimens in collections. The host plant is unknown.

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